



Research Article

Prevalence and Risk Factors of Rumen and Reticulum Foreign Bodies in Slaughtered Sheep and Goats in Peshawar, Pakistan

Nadeem Iqbal¹, Haider Ali Yousafzai¹, Awais Ahmad², Muhammad Salar², Abdul Kabir^{2,3*} and Abdul Rehman

¹Livestock and Dairy Development Department Khyber Pakhtunkhwa, Pakistan; ²Faculty of Animal Husbandry and Veterinary Sciences Sindh Agriculture University, Tandojam, Pakistan; ³Department of Veterinary Microbiology Faculty of Animal Husbandry and Veterinary Sciences Sindh Agriculture University, Tandojam, Pakistan; ⁴Department of Veterinary Medicine Faculty of Animal Husbandry and Veterinary Sciences Sindh Agriculture University, Tandojam, Pakistan.

Abstract | The ingestion of indigestible foreign bodies (FBs) by small ruminants, often linked to environmental pollution and improper waste management, poses significant health and production challenges in developing countries. This study aimed to determine the prevalence, types, anatomical distribution, and associated risk factors of rumen and reticulum foreign bodies in sheep and goats slaughtered in Peshawar, Pakistan. A cross-sectional abattoir-based study was conducted on 674 small ruminants (403 sheep and 271 goats) using systematic random sampling. Ante-mortem and post-mortem examinations were performed, and data were analyzed using chi-square tests and logistic regression. The overall prevalence was 33.1% (223/674), with goats showing significantly higher prevalence (45.0%) than sheep (25.1%). Plastic materials were the most common foreign bodies (48.4%), followed by mixed materials (28.3%), cloth (17.0%), and ropes (6.3%). Significant risk factors included: goat species (AOR = 2.25), emaciated body condition (AOR = 5.60), age 2–4 years (AOR = 2.44), and urban origin (AOR = 1.60). Foreign bodies were predominantly located in the rumen (54.1%). This study highlights a high burden of foreign body ingestion in small ruminants in Peshawar, strongly associated with plastic pollution and poor waste management. Interventions focusing on environmental cleanliness, controlled grazing, and community awareness are recommended to mitigate this issue.

Editor | Muhammad Abubakar, National Veterinary Laboratories, Park Road, Islamabad, Pakistan.

Received | February 11, 2026; **Accepted** | February 25, 2026; **Published** | March 31, 2026

***Correspondence** | Abdul Kabir, Faculty of Animal Husbandry and Veterinary Sciences Sindh Agriculture University, Tandojam, Pakistan; Email: kabirvet32@gmail.com

Citation | Iqbal, N., H.A. Yousafzai, A. Ahmad, M. Salar, A. Kabir and A. Rehman. 2026. Prevalence and risk factors of rumen and reticulum foreign bodies in slaughtered sheep and goats in Peshawar, Pakistan. *Veterinary Sciences: Research and Reviews*, 12(1): 46-54.

DOI | <https://dx.doi.org/10.17582/journal.vsr/2026/12.1.46.54>

Keywords | Small ruminants, Rumen reticulum, Foreign bodies ingestion, Abattoir-based study, Risk factors, Pakistan



Copyright: 2026 by the authors. Licensee ResearchersLinks Ltd, England, UK.

This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Introduction

Ruminant livestock, including sheep (*Ovis aries*) and goats (*Capra hircus*), are crucial for

the livelihoods of rural and urban communities in Pakistan, providing meat, milk, wool, and draught power (Ahmad *et al.*, 2024). However, these animals are highly susceptible to ingestion of indigestible

foreign materials, which often accumulate in the rumen and reticulum, leading to digestive disorders, poor productivity, and even mortality (Duresa *et al.*, 2022). Such conditions not only threaten animal health but also have significant economic implications for smallholder farmers and the livestock industry (Kappes *et al.*, 2023).

Several studies conducted across different regions of the world, including Africa, the Middle East, and South Asia, have reported variable prevalence rates of rumen and reticulum foreign bodies in small ruminants and have identified multiple associated risk factors. These factors commonly include age, sex, body condition score, species, and geographical origin of the animals (Ibrahim *et al.*, 2024; Fasil, 2016). Studies from Pakistan have similarly documented the presence of indigestible foreign materials in sheep and goats, particularly in areas experiencing rapid urbanization and poor solid waste management (Rizwan *et al.*, 2024; Riaz *et al.*, 2023). Older animals and those with poor or emaciated body condition scores are generally more susceptible to foreign body ingestion. This increased susceptibility is attributed to prolonged exposure to contaminated environments, chronic feed scarcity, mineral deficiencies, and the development of non-selective feeding behavior over time (Khattak *et al.*, 2023; Ahmad *et al.*, 2024).

Additionally, animals reared in urban and peri-urban settings are at higher risk due to unrestricted access to plastic waste, textile materials, and other non-biodegradable refuse commonly discarded in grazing areas and around marketplaces (Monguno *et al.*, 2023). Despite the increasing burden of plastic pollution and unregulated waste disposal in Khyber Pakhtunkhwa province, particularly in densely populated cities such as Peshawar, data on the prevalence and risk factors of rumen and reticulum foreign bodies in slaughtered sheep and goats remain scarce (Khaliq *et al.*, 2024). This lack of localized data limits the development of targeted prevention and control strategies for small ruminant production systems in the region (Kimeli *et al.*, 2025). Understanding the occurrence and determinants of foreign body ingestion in small ruminants is therefore essential for improving animal welfare, enhancing productivity, and minimizing economic losses. Accordingly, the present study aimed to determine the prevalence of indigestible foreign bodies in the rumen and reticulum of slaughtered sheep and goats in Peshawar, Pakistan, and to identify

potential risk factors associated with their occurrence, including age, sex, species, body condition score, and source of animals. The findings of this study are expected to provide valuable baseline information for veterinarians, farmers, and policymakers to design effective and evidence-based preventive strategies for this common yet preventable condition in small ruminants.

Materials and Methods

Study area and period

A cross-sectional abattoir-based study was conducted at the Peshawar Central Slaughterhouse and selected major private slaughter points in Peshawar district, Khyber Pakhtunkhwa, Pakistan, from January to April 2024, covering late winter and early spring when small ruminant slaughter rates are typically high. Peshawar (34°00'55"N, 71°34'04"E) is the provincial capital, located at an altitude of 359 m above sea level, with a population exceeding 2.3 million. The climate during the study period was mild, with temperatures ranging from 8–25 °C and low rainfall, characteristic of the region's semi-arid conditions. Selected abattoirs were chosen based on their high throughput (approximately 150–200 small ruminants per day) including urban, peri-urban (sub-urban), and rural areas across the district and surrounding regions, this ensured representation of the regional small ruminant population.

Study design and population

A cross-sectional abattoir-based study was conducted over a four-month period from January to April 2024. The study population consisted of all sheep and goats presented for routine commercial slaughter at the selected facilities during this period. A total of 674 small ruminants were examined. This included 403 sheep and 271 goats, proportions reflecting the approximate 3:2 slaughter ratio observed in local markets. Animals were selected via systematic random sampling. Based on the average daily slaughter volume, every 3rd animal in the slaughter queue was selected on each visit (conducted three times per week) until the target sample was achieved. Only animals processed for standard commercial purposes were included.

Data collection

Ante-mortem examination and data recording: Prior to slaughter, each selected animal was individually

marked and subjected to a standardized ante-mortem examination. Information regarding species was recorded by identifying the animals as *Ovis aries* (sheep) or *Capra hircus* (goat). Sex was documented as male or female. Age was estimated based on dentition patterns, including incisor eruption and wear, and animals were classified as young (< 2 years), adult (2–4 years), or old (> 4 years). Body condition score was assessed through visual inspection and palpation of the lumbar region and categorized as good, medium, or poor/emaciated according to ESGPIP (2009). The geographical source of each animal was documented based on information provided by animal traders and classified as urban (Peshawar city), peri-urban (sub-urban areas within approximately 20 km), or rural (villages located beyond 20 km).

Post-mortem examination and sample collection

Immediately after standard halal slaughter and evisceration, the forestomach, including the rumen and reticulum, was carefully isolated from each animal. The organs were opened along their greater curvature, and the contents were completely emptied into labeled containers for detailed examination. The examination involved systematic visual inspection and manual palpation of the mucosal surfaces and contents. The collected material was washed through a 2 mm mesh sieve to recover all particulate matter. Any indigestible foreign material was collected, thoroughly washed with clean water, air-dried, and categorized accordingly. For each animal, data were recorded regarding the presence or absence of foreign bodies, their total quantity, the type of material identified (plastic, rope, cloth/textile, mixed materials, metal, or others), and the primary anatomical location of occurrence, whether in the rumen, reticulum, or both.

Results

Overall prevalence of indigestible rumen and reticulum foreign bodies

A total of 674 small ruminants (403 sheep and 271 goats) were examined for the presence of indigestible foreign bodies (FBs) in the rumen and reticulum at Peshawar slaughterhouses. As shown in Table 1, the overall prevalence was 33.1% (223/674). A significant species difference was observed ($\chi^2 = 28.25$, $p < 0.001$), with goats exhibiting a markedly higher prevalence (45.0%, 122/271) compared to sheep (25.1%, 101/403).

Table 1: Overall prevalence of indigestible rumen and reticulum foreign bodies in sheep and goats.

Species	Number of animals examined	Number of animals with foreign body	Prevalence (%)	Chi square (χ^2)	P value
Sheep	403	101	25.1	28.25	< 0.001
Goat	271	122	45.0		
Total	674	223	33.1		

Types and distribution of foreign bodies

The types of foreign materials recovered are detailed in Figure 1. Plastic bags were the most commonly encountered foreign bodies, accounting for 48.43% (108/223) of all materials found, followed by mixed materials (28.25%), clothes (17.04%), and ropes (6.28%). While plastic bags constituted the highest proportion in both species, species-specific patterns emerged: sheep showed relatively higher proportions of plastic bags and clothes, whereas goats had higher proportions of ropes and mixed materials.

Composition of Foreign Bodies (n=223)

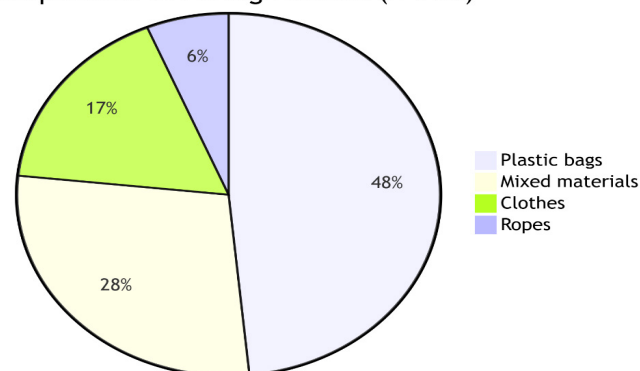


Figure 1: Various types of indigestible rumen foreign bodies in sheep and goats.

Association of foreign bodies with animal demographics

Age association

Figure 2 presents the prevalence of foreign bodies according to age groups. Prevalence showed a significant increasing trend with age ($\chi^2 = 12.72$, $p = 0.002$). The lowest prevalence was observed in young animals (<2 years) at 19.75%, which increased to 34.87% in adults (2–4 years) and reached 39.05% in older animals (>4 years).

Sex association

The distribution by sex (Figure 3) showed a slightly higher prevalence in females (36.14%) compared to males (31.06%). However, this difference was not statistically significant ($p > 0.05$) in the initial chi-square analysis.

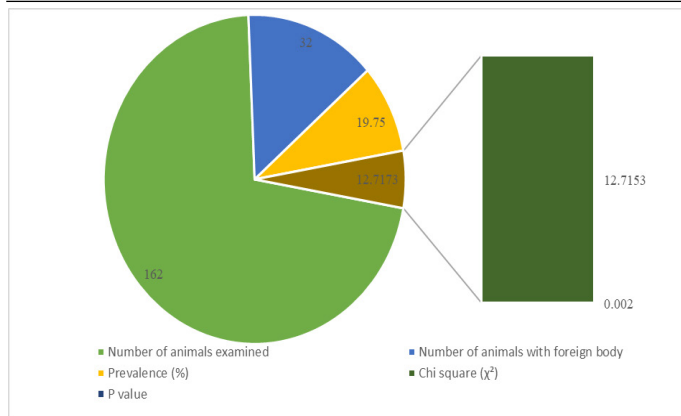


Figure 2: Prevalence of indigestible rumen and reticulum foreign bodies in sheep and goats according to age.

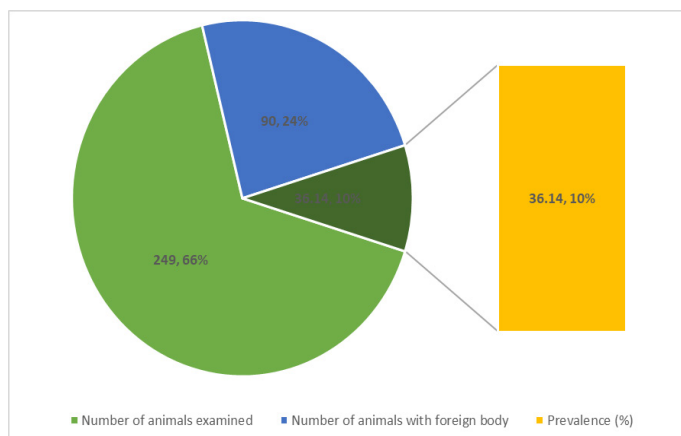


Figure 3: Prevalence of indigestible rumen and reticulum foreign bodies in sheep and goats according to sex.

Body condition association

Body condition showed a strong and significant association with foreign body occurrence (Figure 4). Animals classified as emaciated/thin had the highest prevalence (45.5%), followed by those with medium body condition (24.8%), while animals in good condition had the lowest prevalence (4.9%) ($\chi^2 = 12.53$, $p = 0.002$).

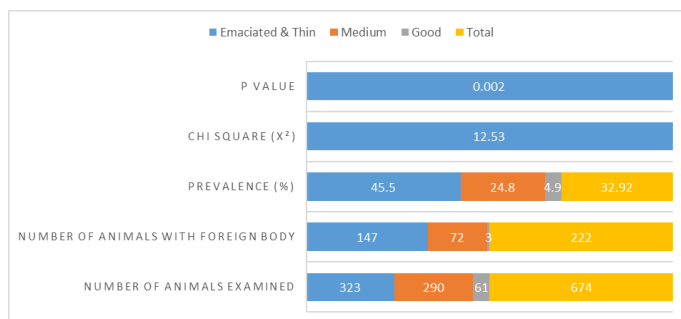


Figure 4: Prevalence of indigestible rumen and reticulum foreign bodies in sheep and goats according to body condition.

Anatomical distribution of foreign bodies

The anatomical location of recovered foreign bodies is shown in Figure 5. The majority (54.1%) were found

exclusively in the rumen, followed by the reticulum alone (31.1%), while 14.9% were present in both compartments simultaneously.

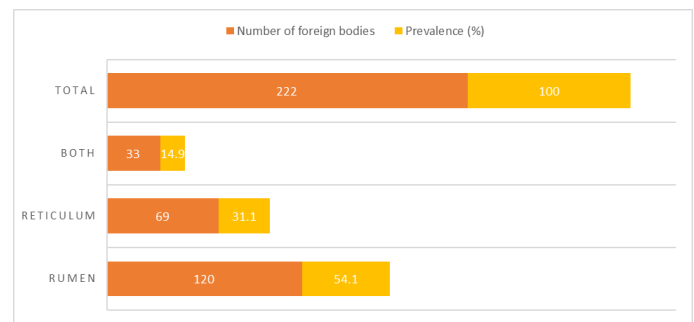


Figure 5: Occurrence of foreign bodies in rumen and reticulum of sheep and goats (674 animals, 222 positives).

Risk factor analysis using logistic regression

Both univariable and multivariable logistic regression were performed to identify risk factors for foreign body ingestion (Table 2). Species was a strong predictor: Goats had 2.25 times higher odds of harboring foreign bodies than sheep (AOR= 2.25, 95% CI: 1.53–3.89, $p = 0.001$). Age remained significantly associated, with animals aged 2–4 years having 2.44 times higher odds than those >4 years (AOR= 2.44, 95% CI: 1.26–2.78, $p = 0.001$), whereas young animals (<2 years) had lower odds (AOR= 0.56, 95% CI: 0.33–0.95, $p = 0.03$). Body condition was a crucial factor; emaciated animals had 5.60 times higher odds than those in good condition (AOR= 5.60, 95% CI: 1.56–20.04, $p = 0.008$). Geographical source also showed significance: urban animals had 1.60 times higher odds than rural animals (AOR= 1.60, 95% CI: 1.02–2.50, $p = 0.03$). Sex did not show a statistically significant association ($p = 0.091$).

Discussion

This cross-sectional abattoir-based study provides important insights into the prevalence, characteristics, and risk factors associated with indigestible foreign body (FB) ingestion in small ruminants in Peshawar, Pakistan. The findings reveal a significant animal health and welfare concern linked to environmental pollution and management practices in the region.

The overall prevalence of rumen and reticulum foreign bodies in our study was 33.1%, indicating that approximately one in three slaughtered small ruminants in Peshawar harbors indigestible materials. This prevalence falls within the range (15–55%) reported in similar abattoir studies from developing countries,

Table 2: Univariable and multivariable logistic regression analysis of presumptive risk factors of indigestible rumen and reticulum foreign bodies in sheep and goats.

Variables	Category	No. examined	No. positive (%)	COR (95% CI)	p-value	AOR (95% CI)	p-value
Age group	< 2 years	141	27	0.53 (0.33–0.88)	0.01*	0.56 (0.33–0.95)	0.03*
	2–4 years	201	71	1.87 (1.26–2.78)	0.002*	2.44 (1.26–2.78)	0.001*
	> 4 years	232	91	Ref	Ref	Ref	Ref
Species	Caprine	224	101	2.56 (1.79–3.67)	0.001*	2.25 (1.53–3.89)	0.001*
	Ovine	350	88	Ref	Ref	Ref	Ref
Body condition score	Good	52	3	Ref	Ref	Ref	Ref
	Medium	247	61	3.05 (0.89–0.45)	0.07	2.13 (0.58–7.74)	0.25
	Emaciated	275	125	5.82 (1.72–19.65)	0.005*	5.60 (1.56–20.04)	0.008*
Sex	Male	362	112	Ref	Ref	Ref	Ref
	Female	212	77	1.33 (0.83–1.07)	0.116	1.40 (0.94–2.08)	0.091
Source of the animals	Urban	201	83	1.92 (1.27–2.89)	0.002*	1.60 (1.02–2.50)	0.03*
	Sub-Urban	156	54	1.11 (0.70–1.76)	0.62	0.87 (0.52–1.47)	0.62
	Rural	217	52	Ref	Ref	Ref	Ref

including Ethiopia (32.9%) (Mohammed *et al.*, 2025), India (28.6%) (Ramanujam *et al.*, 2022), and Nigeria (36.4%) (Dauda *et al.*, 2025) but is substantially higher than reports from regions with stricter waste management (2–8%) (Mmereki *et al.*, 2016). This disparity highlights the direct correlation between environmental pollution levels and foreign body ingestion in grazing animals.

A striking finding was the significantly higher prevalence in goats (45.0%) compared to sheep (25.1%), with goats having 2.25 times higher odds of FB ingestion. This species difference has been consistently observed across multiple studies (Kronqvist *et al.*, 2021; Brand *et al.*, 2017) and can be attributed to several factors. Goats are natural browsers with more selective yet exploratory feeding behaviors, often investigating and consuming novel objects in their environment (Cellier *et al.*, 2022). Their greater agility and climbing ability may also provide access to waste dumps and contaminated areas that sheep cannot reach. Additionally, goats' well-documented dietary curiosity and lower feed selectivity make them particularly vulnerable to ingesting non-food items when nutritional needs are not met (Ayesiga *et al.*, 2024).

Plastic materials constituted nearly half (48.43%) of all foreign bodies recovered, with plastic bags being the most predominant. This finding aligns with global trends where plastic pollution has become the foremost environmental contaminant affecting

livestock health (Corte-Pause *et al.*, 2024; Akanda *et al.*, 2025). The ubiquitous presence of plastic bags in grazing areas, roadsides, and dumping sites creates a continuous exposure risk. Once ingested, plastics accumulate in the forestomach due to their non-digestible nature and can cause physical obstruction, reduce rumen capacity, and potentially release toxic compounds (Galyon, 2022).

The higher proportion of clothes in sheep and ropes/mixed materials in goats may reflect species-specific grazing/browsing patterns and environmental exposures. Sheep, being grazers, are more likely to encounter textile materials in grasslands, while browsing goats may encounter more diverse materials in shrubs and waste areas (García *et al.*, 2012). This differentiation in FB types by species has practical implications for targeted intervention strategies.

Our study revealed a clear age-dependent increase in FB prevalence, with the lowest rates in young animals (<2 years: 19.75%) and highest in older animals (>4 years: 39.05%). Animals aged 2–4 years had 2.44 times higher odds of FB presence compared to the oldest group. This accumulation effect over time is well-documented (Mateos *et al.*, 2018), as foreign bodies, particularly non-metallic ones like plastics, rarely pass spontaneously from the ruminant forestomach and tend to accumulate throughout an animal's life. Younger animals may also have more selective feeding behaviors and spend less time foraging independently in contaminated areas.

The strongest association identified was between poor body condition and FB ingestion, with emaciated animals having 5.60 times higher odds of harboring foreign bodies. This finding has been consistently reported across studies (Nongcula *et al.*, 2017; Mulatu *et al.*, 2018) and suggests two possible interrelated mechanisms: (1) foreign bodies cause chronic health issues leading to emaciation, or (2) nutritionally deprived animals exhibit pica behavior, consuming non-food items in an attempt to satisfy hunger or mineral deficiencies (Kochan *et al.*, 2023). The direction of this relationship requires further investigation through longitudinal studies, but it clearly indicates that FB ingestion is both a cause and consequence of poor nutritional status.

Animals originating from urban areas had significantly higher odds (AOR= 1.60) of containing foreign bodies compared to their rural counterparts. This urban–rural gradient likely reflects differential exposure to waste pollution, as urban and peri-urban grazing areas in developing countries often serve as informal waste disposal sites (Douglas, 2008). Additionally, urban livestock management typically involves more scavenging and less controlled grazing than traditional rural systems (Prasad *et al.*, 2019). The non-significant association with peri-urban (sub-urban) sources suggests a threshold effect of urbanization or mixed management practices in these transitional zones.

The predominant location of foreign bodies in the rumen (54.1%) rather than the reticulum (31.1%) aligns with the physiological roles of these compartments. The rumen, being the primary fermentation chamber with slower content movement, is more likely to retain lighter materials like plastics and textiles (Galyon, 2022). Reticular location, while less common, is clinically more significant as pointed objects there can lead to traumatic reticuloperitonitis (hardware disease) (Zakir and Abdo, 2022). The 14.9% occurrence in both compartments suggests either multiple ingestion events or material migration, warranting further investigation into FB dynamics within the forestomach.

While providing valuable insights, this study has several limitations. As a cross-sectional abattoir study, it captures only animals that reached slaughter and may underestimate the true population prevalence, as severely affected animals might die or be culled

earlier. The age estimation method, while standard, has inherent inaccuracies. Additionally, information on animal origin relied on trader reports, which may not always be precise. Future studies incorporating farmer interviews, longitudinal designs, and chemical analysis of foreign materials would provide more comprehensive understanding.

The high prevalence of foreign body ingestion, particularly plastics, represents both an animal welfare concern and an economic loss for smallholder farmers in Pakistan. Our findings suggest several targeted interventions:

- Environmental management: Strengthening municipal waste collection and disposal systems, particularly banning or regulating plastic bags, is urgently needed (Vanapalli *et al.*, 2021).
- Animal management: Implementing controlled grazing practices, providing adequate nutrition to prevent pica, and regular herd health monitoring can reduce FB ingestion risks.
- Farmer education: Awareness programs should highlight the economic impacts of FB ingestion and promote regular removal of waste from grazing areas.
- Policy action: Integration of livestock health considerations into urban planning and environmental policies could help address this intersection of animal, human, and environmental health (One Health).

Conclusion

This study demonstrated a 33.1% prevalence of indigestible foreign bodies in small ruminants slaughtered in Peshawar, Pakistan. Plastic materials were the most frequently recovered items, indicating a strong association between environmental pollution and livestock health. Higher risk was observed in goats, older animals, those with poor body condition, and animals originating from urban areas.

These findings highlight the need for improved waste management, better grazing control, and increased farmer awareness. Further longitudinal studies are recommended to clarify causal relationships and estimate the associated economic losses.

Acknowledgement

We thank the staff of Peshawar slaughterhouses for

their cooperation, and the animal traders for providing origin information. Technical assistance from laboratory and data entry personnel is acknowledged.

Novelty Statement

This work presents the first systematic evidence linking plastic pollution and foreign body ingestion in small ruminants in Peshawar, Pakistan, identifying goats, emaciated animals, and urban origin as key risk factors novel insights for regional livestock and environmental management.

Author's Contribution

AK conceived and supervised the study, analyzed data, and finalized the manuscript. ND conducted fieldwork and data collection. HAY and AA assisted in data analysis. MS contributed to study design and supervision. AR helped revise the manuscript. All authors read and approved the final version of the manuscript.

Generative AI and AI-assisted technology statement

No AI tool was used for data analysis, result generation, or decision-making. All interpretations and conclusions are the sole responsibility of the authors.

Conflict of interest

The authors have declared no conflict of interest.

References

- Ahmad, N., Yuan, H., Zhu, Z., Chu, T., Liu, J. and Song, Y., 2024. Pakistan sheep industry its constrains and future trends. *Trop. Anim. Hlth. Prod.*, 56(9): 399. <https://doi.org/10.1007/s11250-024-04246-x>
- Akanda, M.R., Kawsar, M.A., Sabuj, M.S.S., Ashik-Uz-Zaman, M., Siddiqui, M.S.I. and Hossain, M.A., 2025. Microplastic pollution in livestock farming in Bangladesh: A critical review of its key findings and mitigation strategies to address public health. *Environ. Monit. Assess.*, 197(7): 732. <https://doi.org/10.1007/s10661-025-14132-0>
- Ayesiga, I., Iqbal, S., Kyejjusa, Y., Okoboi, J., Omara, T., Adelina, T. and Kahwa, I., 2024. Key regulatory aspects of prebiotics, probiotics, and synbiotics in the management of metabolic disorders. In: *Synbiotics in metabolic disorders*. CRC Press. pp. 214-244. <https://doi.org/10.1201/9781032702438-14>
- Brand, T.S., Van Der Merwe, D.A., Swart, E. and Hoffman, L.C., 2017. Comparing the effect of age and dietary energy content on feedlot performance of Boer goats. *Small Rumin. Res.*, 157: 40-46. <https://doi.org/10.1016/j.smallrumres.2017.10.009>
- Cellier, M., Nielsen, B.L., Duvaux-Ponter, C., Freeman, H.B., Hannaford, R., Murphy, B. and Zobel, G., 2022. Browse or browsing: Investigating goat preferences for feeding posture, feeding height and feed type. *Front. Vet. Sci.*, 9: 1032631. <https://doi.org/10.3389/fvets.2022.1032631>
- Corte-Pause, F., Urli, S., Crociati, M., Stradaoli, G. and Baufeld, A., 2024. Connecting the dots: Livestock animals as missing links in the chain of microplastic contamination and human health. *Animals*, 14(2): 350. <https://doi.org/10.3390/ani14020350>
- Dauda, I.D., Binhambali, A., Jibril, A.H., Idris, Z.O. and Akorede, F.R., 2025. Economic impact of fetal wastage and common diseases, along with their incidence rates and seasonal variations, at an abattoir in FCT, Nigeria. *PLoS One*, 20(2): e0310806. <https://doi.org/10.1371/journal.pone.0310806>
- Douglas, I., 2008. Environmental change in peri-urban areas and human and ecosystem health. *Geogr. Compass*, 2(4): 1095-1137. <https://doi.org/10.1111/j.1749-8198.2008.00122.x>
- Duresa, L.A., Kitessa, J.D. and Feyissa, C.T., 2022. Prevalence of indigestible foreign bodies and its associated potential risk factors in rumen and reticulum of domestic ruminants at Bishoftu Elfora export abattoir. *Vet. Med. Sci.*, 8(6): 2623-2630. <https://doi.org/10.1002/vms3.952>
- Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), 2009. Body Condition Scoring of Sheep and Goats. Technical Bulletin No. 8; Addis Ababa, Ethiopia: ESGPIP.
- Fasil, N., 2016. Assessment of sheep and goat foreign bodies in rumen and reticulum in the *Jigjiga municipal* Abattiar. *J. Adv. Dairy Res.*, 4(3): 157. <https://doi.org/10.4172/2329-888X.1000157>
- Galyon, H.R., 2022. Ruminal degradation of polyhydroxyalkanoate and poly (butylene

- succinate-co-adipate) (Doctoral dissertation, Virginia Tech).
- García, R.R., Celaya, R., García, U. and Osoro, K., 2012. Goat grazing, its interactions with other herbivores and biodiversity conservation issues. *Small Rumin. Res.*, 107(2-3): 49-64. <https://doi.org/10.1016/j.smallrumres.2012.03.021>
- Ibrahim, L., Mesfin, B. and Regasa, A., 2024. Prevalence of rumen and reticulum indigestible foreign body in goat at *Haramaya municipal Abattoir*, Ethiopia. *Arch. Vet. Sci. Med.*, 7(1): 1-10. <https://doi.org/10.26502/avsm.039>
- Kappes, A., Tozoooneyi, T., Shakil, G., Railey, A.F., McIntyre, K.M., Mayberry, D.E. and Marsh, T.L., 2023. Livestock health and disease economics: A scoping review of selected literature. *Front. Vet. Sci.*, 10: 1168649. <https://doi.org/10.3389/fvets.2023.1168649>
- Khaliq, Z., Ashraf, M.B., Abbasi, N.A., Ahmad, S.R., Shahid, S.U. and Qadir, A., 2024. Assessment of microplastics in gastrointestinal tract of cattle egret (*Bubulcus ibis*) from a metropolitan city Lahore, Pakistan. *Environ. Sci. Pollut. Res.*, 31(56): 64903-64912. <https://doi.org/10.1007/s11356-024-35540-8>
- Khattak, I., Akhtar, A., Shams, S., Usman, T., Haider, J., Nasreen, N. and Said, M.B., 2023. Diversity, prevalence and risk factors associated to gastrointestinal tract parasites in wild and domestic animals from Pakistan. *Parasitol. Int.*, 97: 102777. <https://doi.org/10.1016/j.parint.2023.102777>
- Kimeli, P., Mwacalimba, K., Tiernan, R., Mijten, E., Miroshnychenko, T. and Poulsen, N.B., 2025. Important diseases of small ruminants in sub-Saharan Africa: A review with a focus on current strategies for treatment and control in smallholder systems. *Animals*, 15(5): 706. <https://doi.org/10.3390/ani15050706>
- Kochan, A., Simsek, A. and Arica, E., 2023. Serum mineral levels and haematobiochemical parameters in buffalo calves with allotriophagy (pica syndrome). <https://doi.org/10.21521/mw.6753>
- Kronqvist, C., Kongmanila, D. and Wredle, E., 2021. Effects of replacing grass with foliage on growth rate and feed intake in goats. A systematic review and meta-analysis. *Animals*, 11(11): 3163. <https://doi.org/10.3390/ani11113163>
- Mateos, I., Combes, S., Pascal, G., Cauquil, L., Barilly, C., Cossalter, A.M. and Oswald, I.P., 2018. Fumonisin-exposure impairs age-related ecological succession of bacterial species in weaned pig gut microbiota. *Toxins*, 10(6): 230. <https://doi.org/10.3390/toxins10060230>
- Mmereki, D., Baldwin, A. and Li, B., 2016. A comparative analysis of solid waste management in developed, developing and lesser developed countries. *Environ. Technol. Rev.*, 5(1): 120-141. <https://doi.org/10.1080/21622515.2016.1259357>
- Mohammed, A.A., Wolde, R. and Mahamed, S.A., 2025. Prevalence and associated risk factors of bruise in the bovine carcass slaughtered Jimma Municipal Abattoir, Ethiopia. *Svāsthya: Trends Gen. Med. Publ. Health*, 2(1): e23-e23. <https://doi.org/10.70347/svsthya.v2i1.23>
- Monguno, M. , Umar, U.L. and Prata, J.C., 2023. Impact of poor municipal waste management on ruminant livestock. <https://doi.org/10.21203/rs.3.rs-3390808/v1>
- Mulatu, R., Alemu, S. and Aragaw, K., 2018. Occurrence of indigestible foreign bodies in forestomachs and adjacent structures of cattle slaughtered at Hawassa, Southern Ethiopia. *Am. Euras. J. Sci. Res.*, 13(4): 93-98.
- Nongcula, V.V., Zhou, L., Nhundu, K. and Jaja, I.F., 2017. Association between the prevalence of indigestible foreign objects in the gastrointestinal tract of slaughtered cattle and body condition score. *Animals*, 7(11): 80. <https://doi.org/10.3390/ani7110080>
- Prasad, C.S., Anandan, S., Gowda, N.K., Schlecht, E. and Buerkert, A., 2019. Managing nutrient flows in Indian urban and peri-urban livestock systems. *Nutr. Cycl. Agroecosyst.*, 115(2): 159-172. <https://doi.org/10.1007/s10705-018-9964-0>
- Ramanujam, H., Thiruvengadam, K., Singaraj, R. and Palaniyandi, K., 2022. Role of abattoir monitoring in determining the prevalence of bovine tuberculosis: A systematic review and meta- analysis. *Transb. Emerg. Dis.*, 69(3): 958-973. <https://doi.org/10.1111/tbed.14118>
- Riaz, S., Mehmood, R., Kareem, H.A. and Sadia, H., 2023. Livestock waste, types, sources, pollution potential, and country-wise comparisons. In: *Waste problems and management in developing countries* (pp. 205-231). Apple Academic Press. <https://doi.org/10.1201/9781003283621-9>

- Rizwan, H.M., Zohaib, H.M., Sajid, M.S., Tahir, U.B., Kausar, R., Nazish, N. and Ataya, F.S., 2024. Unveiling the hidden threat: Investigating gastrointestinal parasites and their costly impact on slaughtered livestock. *Rev. Brasil. Parasitol. Vet.*, 33(3): e007224. <https://doi.org/10.1590/s1984-29612024061>
- Vanapalli, K.R., Sharma, H.B., Ranjan, V.P., Samal, B., Bhattacharya, J., Dubey, B.K. and Goel, S., 2021. Challenges and strategies for effective plastic waste management during and post COVID-19 pandemic. *Sci. Total Environ.*, 750: 141514. <https://doi.org/10.1016/j.scitotenv.2020.141514>
- Zakir, S. and Abdo, S., 2022. Review on gastrointestinal foreign bodies in bovine cattle. *Healthc. Rev.*, 2(1): 12-18.